United States Patent [19]

Zimmermann

[11] **4,151,783**

[45] **May 1, 1979**

[54] **APPARATUS FOR SHAPING A LUG ON A STAMPED WORKPIECE**

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[21] Appl. No.: **824,334**

[22] Filed: **Aug. 12, 1977**

[30] **Foreign Application Priority Data**

Aug. 18, 1976 [DE] Fed. Rep. of Germany 2637078

[51] **Int. Cl.**[2] **B23C 1/18;** B24B 9/04; B24B 7/04; B24B 5/16

[52] **U.S. Cl.** ..... **409/165;** 409/190; 409/97; 51/101 R

[58] **Field of Search** ..... 90/14, 20, 11 R, 15 R, 90/15 A, 13.9, 13 R; 51/89, 101 R, 127, 90, 119, 354, 118, 127

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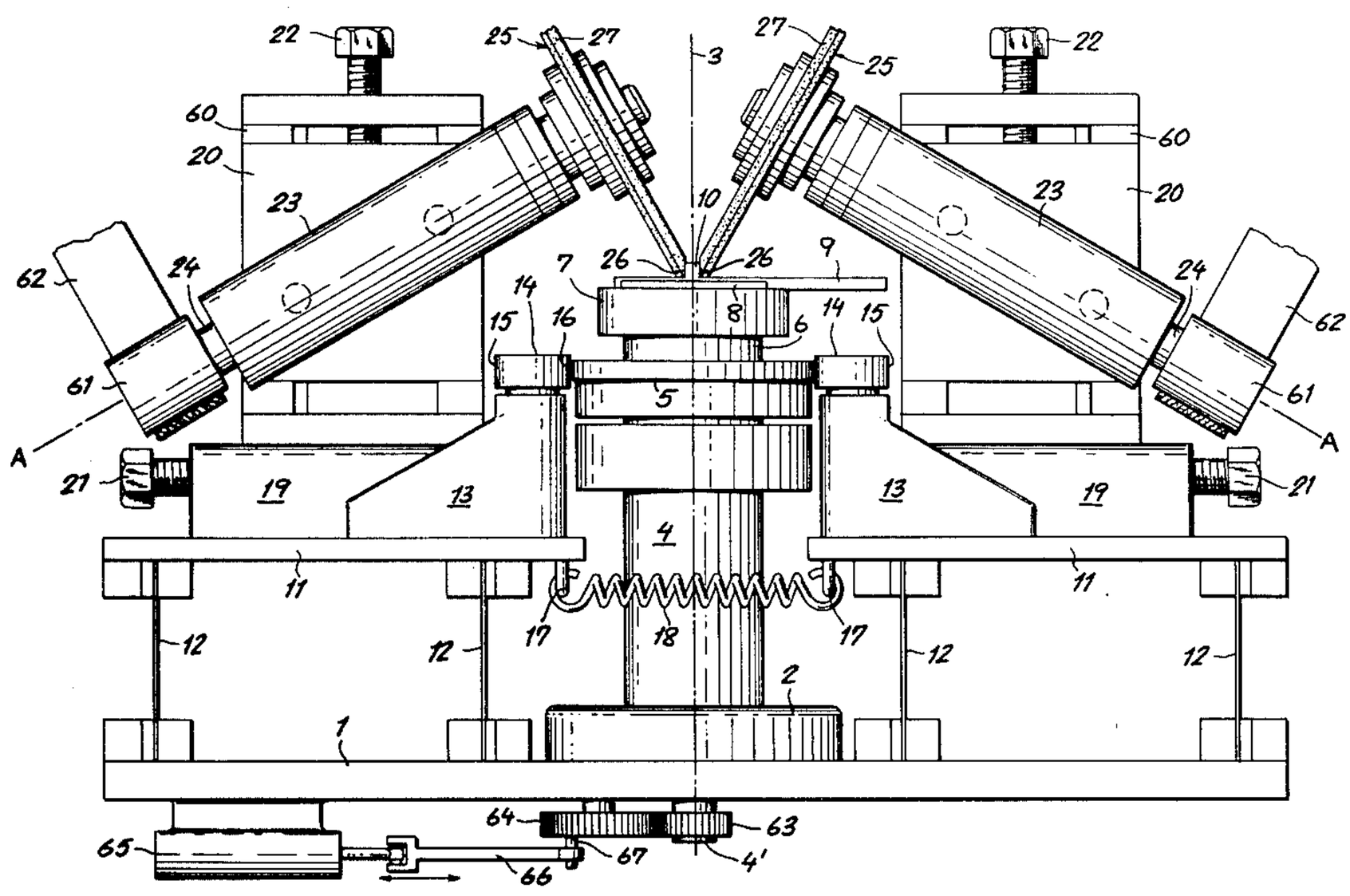
Attorney, Agent, or Firm—Karl F. Ross

[57] **ABSTRACT**

A flat, elongate workpiece such as a knitting-machine needle, stamped from sheet metal with a transverse lug whose narrow faces require precise machining, is clamped in a workpiece holder with its lug centered on an axis about which the workpiece holder and an associated tool mounting are relatively rotatable. The tool mounting includes two symmetrically positioned supports, carrying respective power-driven shaping tools such as grinding wheels or millers, which are limitedly movable in a plane including the axis and are interconnected by a tension spring drawing them toward each other. An interposed cam disk, engaged by rollers mounted on these supports, determines the extent to which the two shaping tools can approach the axis in machining respective lug faces during a relative rotation of up to 180°.

7 Claims, 11 Drawing Figures



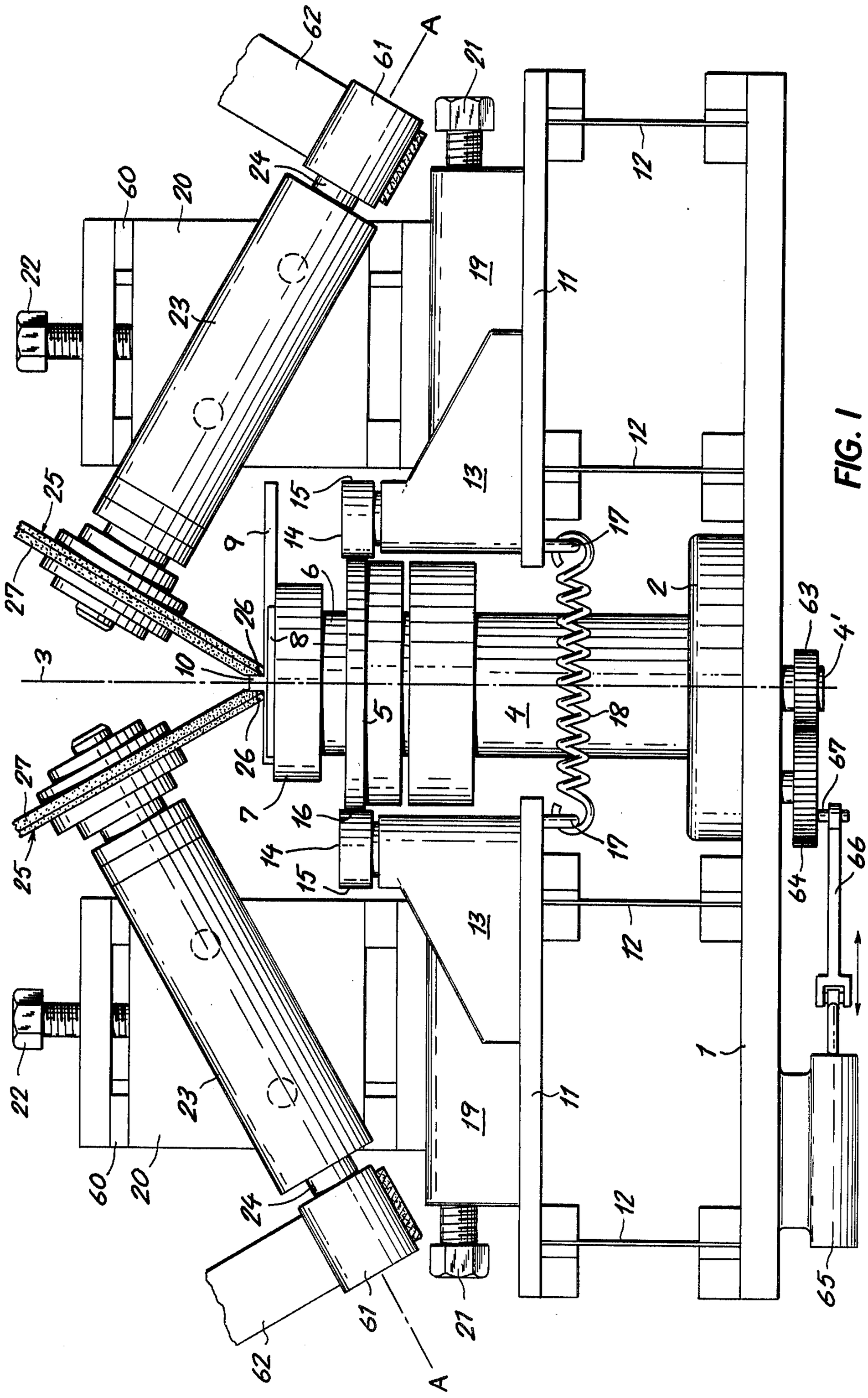

62
61
A
21
24
60
20
22
23
19
11
12
25
27
13
15
14
9
6
17
2
63
4'
26
8
10
3
5
4
18
7
16
67
64
66
1
65

FIG. 1

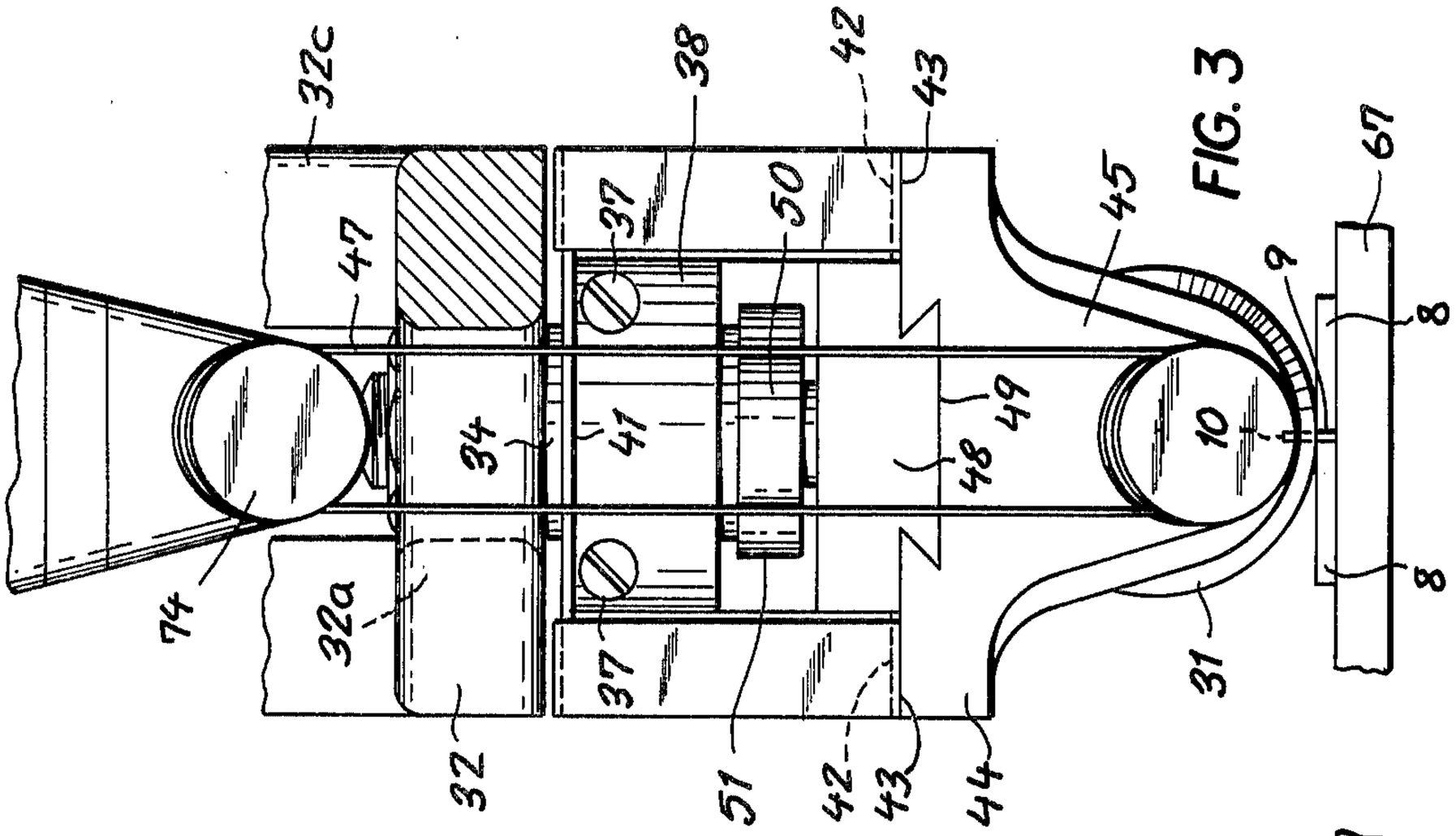
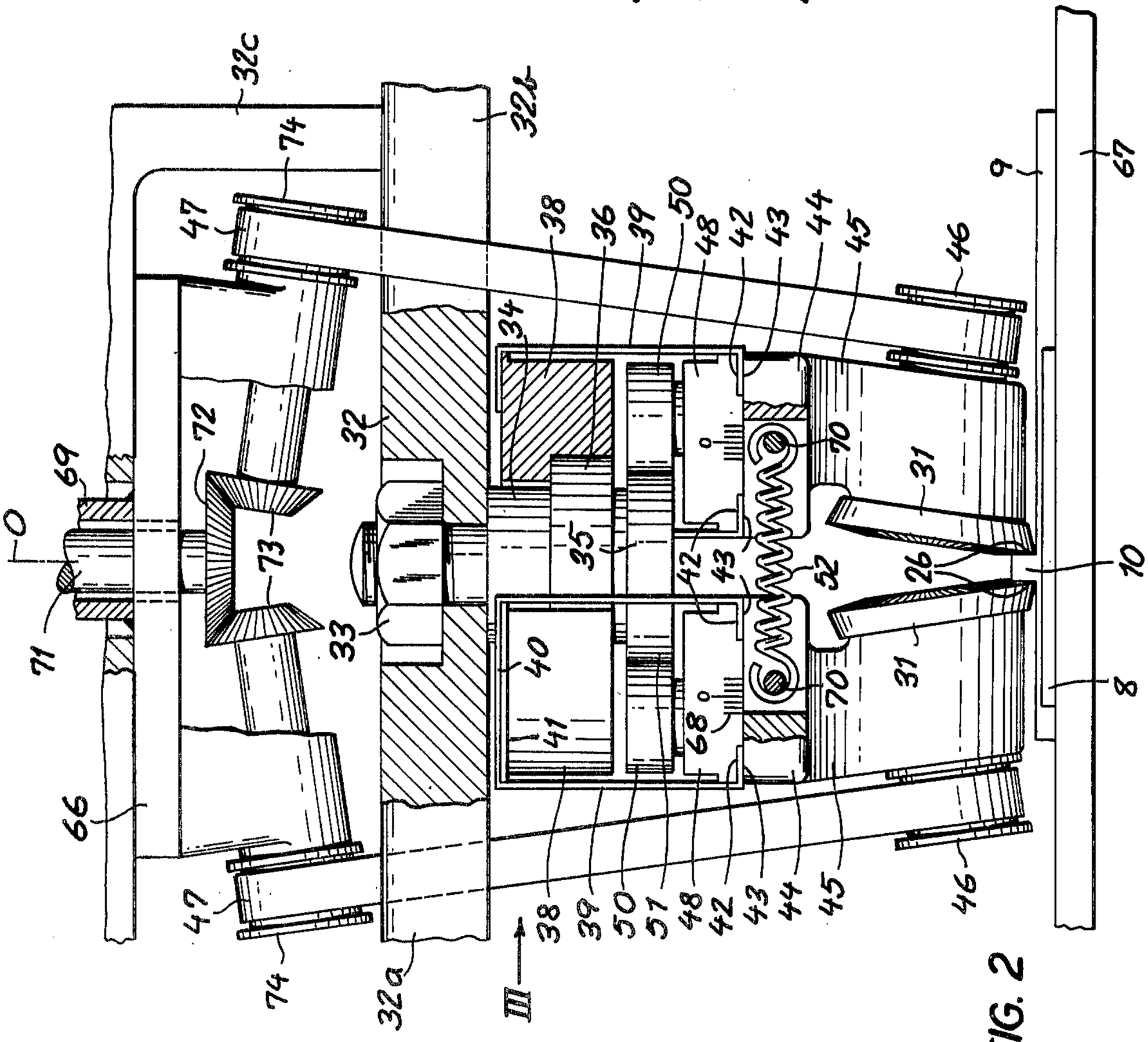

32c
38
42
43
37
50
45
47
9
67
8
34
41
49
48
10
74
32a
31
37
32
51
42
43
44

FIG. 3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9
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34
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26
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71
33
40
41
68
66
III
51

FIG. 2

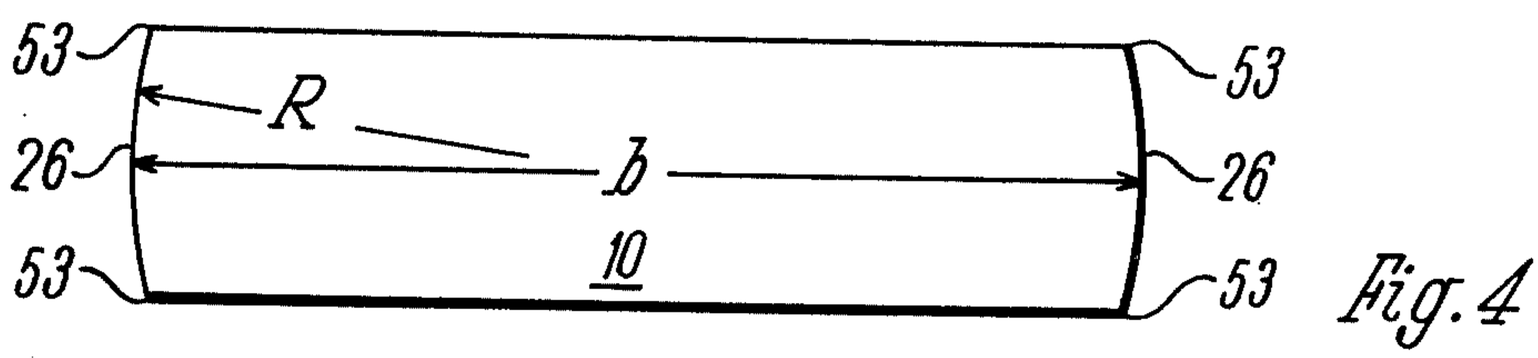

Fig. 4

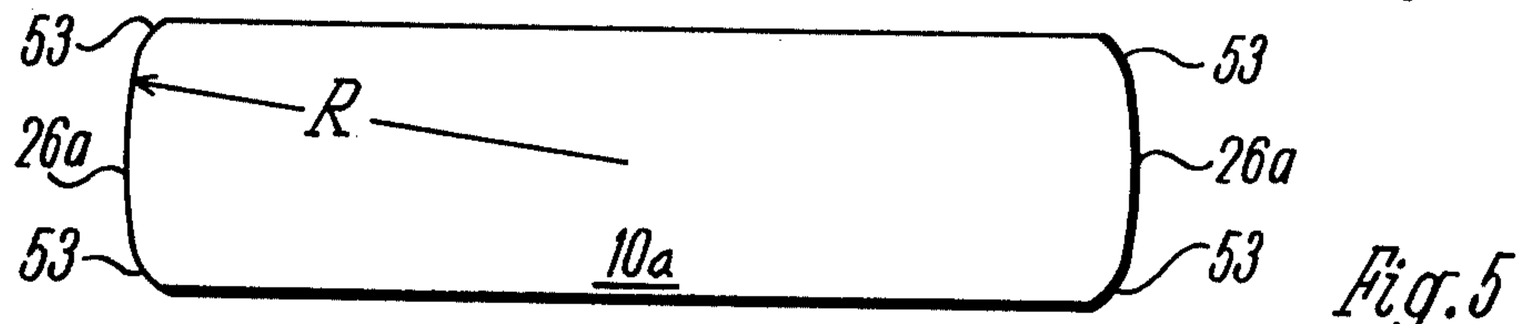

Fig. 5

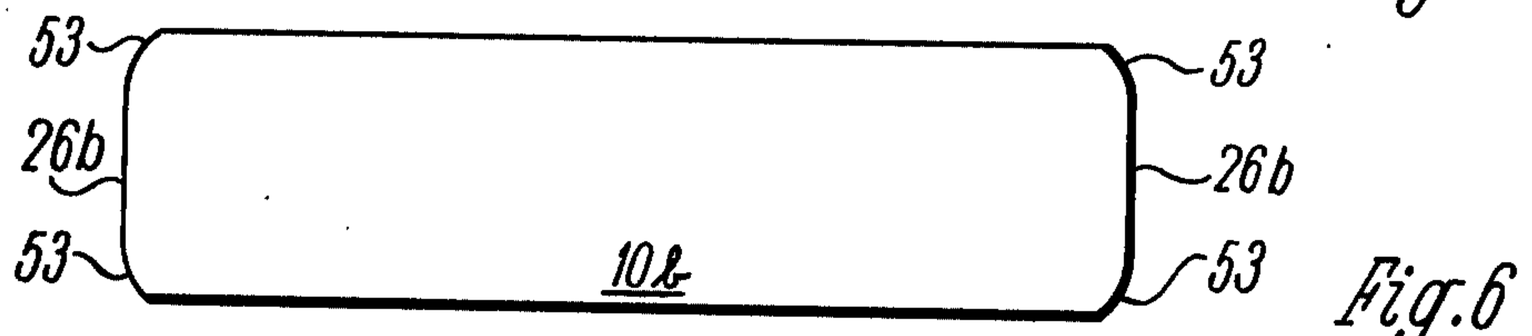

Fig. 6

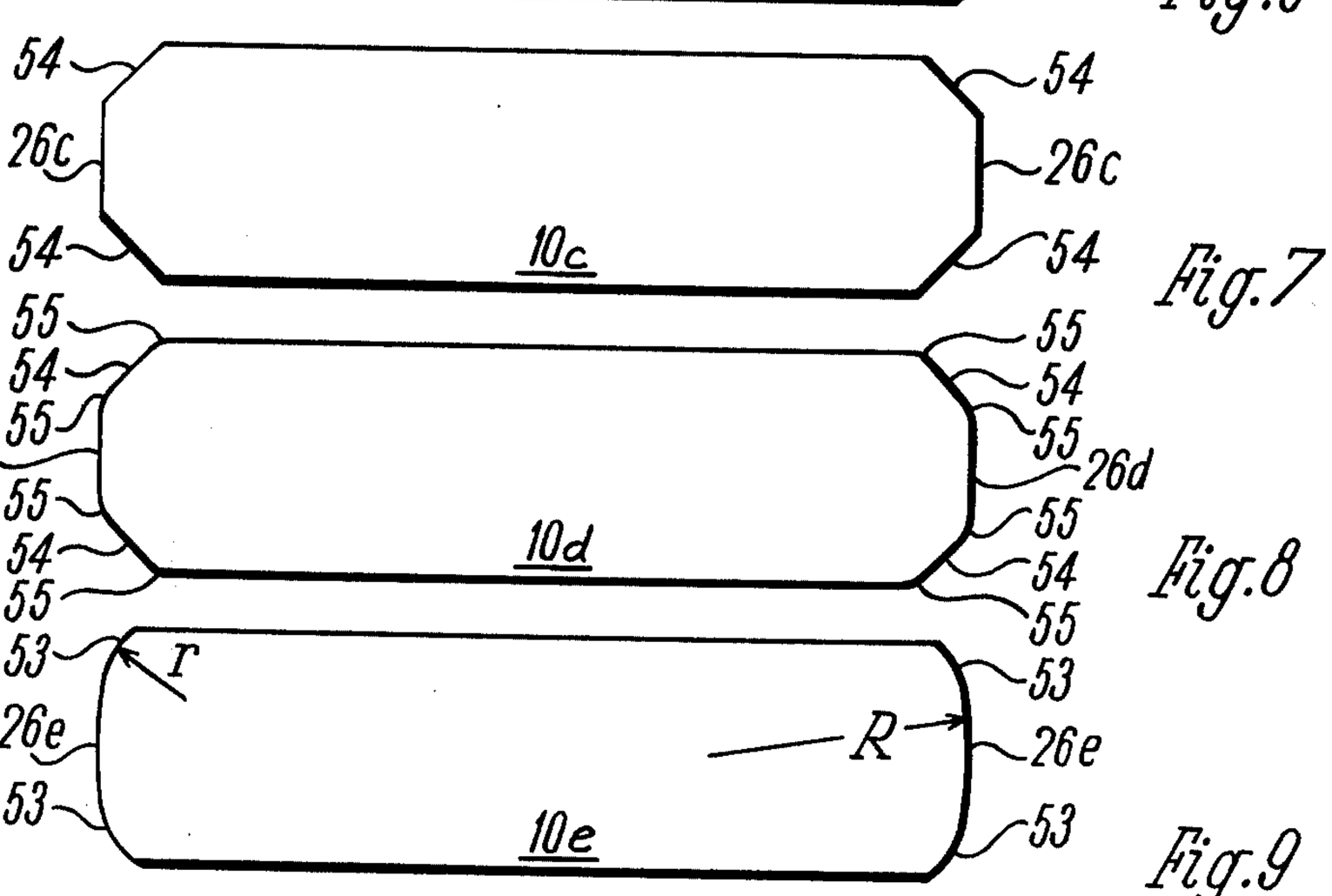

Fig. 7

Fig. 8

Fig. 9

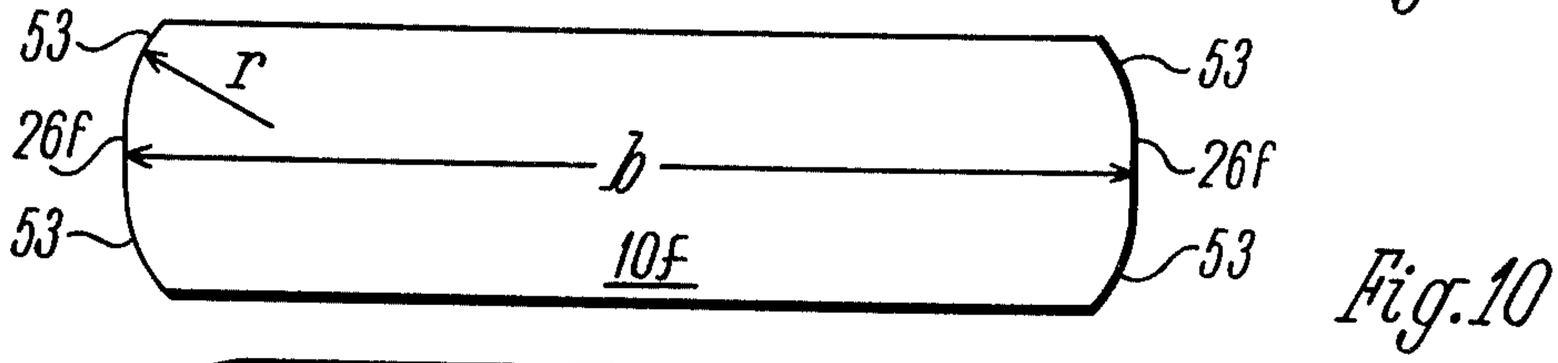

Fig. 10

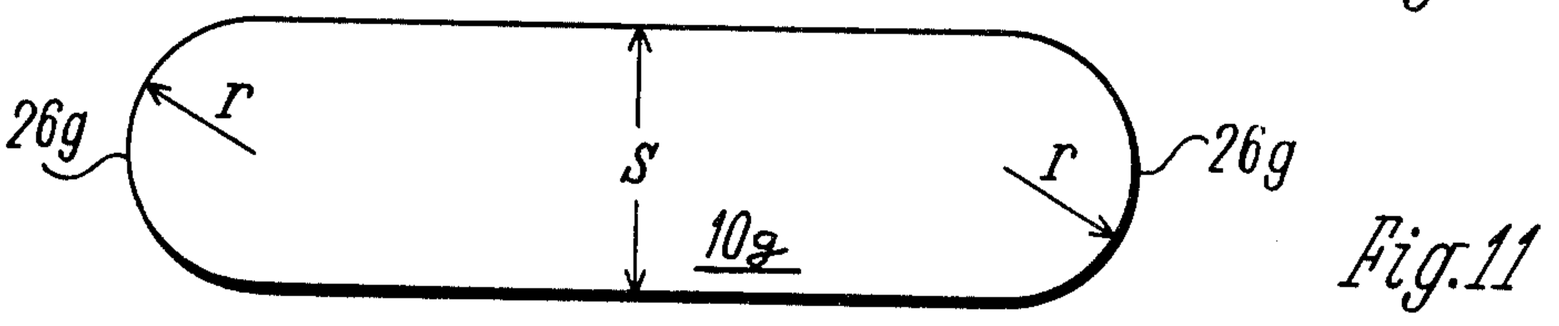

Fig. 11

APPARATUS FOR SHAPING A LUG ON A STAMPED WORKPIECE

FIELD OF THE INVENTION

My present invention relates to an apparatus for shaping opposite narrow faces of a transverse lug on a flat elongate workpiece, such as a needle or a clavette of a knitting machine, stamped from sheet metal.

BACKGROUND OF THE INVENTION

Knitting-machine needles were initially formed from round wire with bent tips serving as cam-follower lugs or butts. The smooth surface of these tips made it easy for them to slide along the camming surfaces of the needle lock. With the development of more sophisticated knitting machines, however, the shape of the needles and similar implements, e.g. clavettes, became more complex, requiring their manufacture by a stamping process from flat sheet steel. The lugs of such stamped workpieces, however, have rough edges which must be smoothed in order to facilitate their displacement within the needle bed and to assure precise coaction with associated cam grooves in which these lugs are usually held captive, opposite edges thereof being thus engaged during ascending and descending strokes.

Various ways have already been proposed in which such camming lugs or butts are to be machined after stamping for smoothing and truing purposes. According to one known process, the two narrow butt faces transverse to the principal dimension of the needle or clavette are beveled at angles of about 45°, yet this requires a succession of separate operating steps with intervening repositioning of the workpiece; such a beveling of the edges of these narrow faces, moreover, generally leaves about 40 to 50% of the original area of these faces in its prior rough condition. If that residual area is also to be machined, the number of grinding of milling operations is further increased and maintenance of the desired tolerances is exceedingly difficult; such a treatment, accordingly, is warranted only in the case of high-precision needles or the like.

Other prior proposals aim at a combined stamping and shaping operation designed to produce a desired butt profile by pressing. That technique, which is applicable only to relatively heavy workpieces, results in the formation of burrs requiring a separate trimming step for their removal.

OBJECTS OF THE INVENTION

The general object of my present invention, accordingly, is to provide an apparatus designed to machine such lugs or butts in an efficient manner on both hardened and nonhardened workpieces which may be of widely varying thickness.

A more particular object is to provide an apparatus of this description which can be conveniently adapted to a diversity of lug profiles.

SUMMARY OF THE INVENTION

I realize these objects, in accordance with my present invention, by providing a tool mounting and a workpiece holder that are relatively rotatable about an axis on which a lug to be machined is centered when the workpiece bearing that lug is clamped on the holder in a position perpendicular to the axis of rotation. A power-driven surface-working tool such as a grinding wheel or a miller is secured to a support so carried on the tool mounting as to be radially displaceable with reference to that axis; in a preferred embodiment, two such supports carrying respective power tools are symmetrically disposed on opposite sides of the axis. Upon relative rotation of the tool mounting and the workpiece holder by suitable drive means, the support or supports are controlledly displaced toward and away from the axis by guide means operatively coupled with the tool mounting and the workpiece holder, the guide means advantageously comprising a cam on the workpiece holder and a cam follower on each radially displaceable support. Although a slave cam could be used, I prefer to provide a simple cam disk peripherally engaged by spring-loaded rollers.

BRIEF DESCRIPTION OF THE DRAWING

The above and other features of my invention will now be described in detail with reference to the accompanying drawing in which:

FIG. **1** is a side-elevational view of an embodiment in which a workpiece holder is rotatable about a vertical axis and co-operates with a pair of grinding wheels supported on a stationary tool mounting;

FIG. **2** is a view generally similar to FIG. **1** but with parts broken away, representing another embodiment with a stationary workpiece holder and a rotatable tool mounting;

FIG. **3** is a side view as seen in the direction III of FIG. **2**; and

FIGS. **4–11** are diagrammatic illustrations, drawn to an enlarged scale, of a variety of lug profiles that can be machined by the apparatus of FIG. **1** or that of FIGS. **2** and **3**.

SPECIFIC DESCRIPTION

The apparatus shown in FIG. **1** comprises a base plate **1** with a bearing **2** in which a shaft **4** is journaled for rotation about a vertical axis **3**. The free upper end of the shaft carries a cam disk **5** topped by a boss **6** of a workpiece holder **7** which has a pair of clamping jaws **8** (only one visible in this Figure) for immobilizing a knitting needle **9** in a diametrical plane; the needle has a transverse lug or butt **10** which rises vertically along the axis in this operating position and whose narrow faces **26** are to be symmetrically machined.

Shaft **4** is flanked by a pair of radially movable supporting plates **11** which are mounted on base plate **1** by respective pairs of resilient legs **12** in the form of leaf springs. Each plate **11** is rigid with a frame **13** carrying a roller **14** whose peripheral surface **15** is maintained in contact with the peripheral surface **16** of disk **5** by a tension spring **18** anchored to eyes **17** on plates **11**.

The two assemblies **11**, **13** thus constitute a pair of carriages that are drawn toward each other by the spring **18** and maintain the rollers **14** engaged with disk **5** at diametrically opposite points.

Each plate **11** further supports a slider **19** guided by the associated frame **13** for relative radial displacement with the aid of an adjusting screw **21** threaded through the slider and rotatably held in the frame. A vertical plate **20** rises above each slider **19**, in the manner of a cross-slide, and is adjustable along a guide frame **60** with the aid of another setting screw **22**. Each plate **20** supports a barrel **23** wherein a shaft **24** is journaled for rotation about a bearing axis A which is inclined to the horizontal, i.e. to a plane perpendicular to central axis **3**. This shaft is keyed to a grinding wheel **25** with a bev-

eled peripheral surface **27** designed to machine a corresponding face **26** of lug **10**. Shaft **24** carries a pulley **61** engaged by a belt **62** through which the grinding wheel **25** can be driven at high speed from a nonillustrated motor.

A downward extension **4'** of shaft **4** is shown to carry a pinion **63** meshing with a larger gear **64** which is journaled on the underside of base plate **1**. An actuator **65**, such as a fluid-operated jack or a solenoid, is linked via a pitman **66** with an eccentric pin **67** on gear **64** to oscillate the latter through an arc sufficient to turn the shaft **4** together with cam disk **5** and workpiece holder **7** through about 180°.

At the start of an operating cycle, with shaft **4** offset by 90° from its illustrated position, cam disk **5** holds the rollers **14** sufficiently far apart to let the lug **10** move freely into and out of the gap between grinding wheels **25** upon separation of the clamping jaws **8**. After the needle **9** has been clamped in position, the tool drive **61**, **62** and the actuator **65** are set in operation, with the grinding wheels approaching each other to begin the machining operation as soon as the edges **53** of the lug **10** are aligned therewith (see FIG. **4**). As the shaft **4** continues its rotation, the two faces **26** are ground, e.g. cylindrically with a radius R as illustrated in FIG. **4**. In this particular instance, the width b of the lug is equal to 2R.

As shown in FIG. **5**, a lug **10*a*** may have its edges **53** curved with a shorter radius than the remainder of faces **26*a***. In FIG. **6** the faces **26*b*** of a lug **10*b*** are flattened. FIG. **7** shows a lug **10*c*** with flattened faces **26*c*** and beveled edges **54**. A lug **10*d***, FIG. **8**, has flat faces **26*d*** and 45° bevels **54** with rounded edges **55**. In FIGS. **9** and **10** I have shown lugs **10*e*, 10*f*** with profiles similar to that of lug **10*a***, FIG. **5**, except for different radii of curvature r of the edge portions **53** flanking the central areas **26*e*, 26*f*** of their faces. FIG. **11**, finally, illustrates a lug **10*g*** with faces **26*g*** of cylindrical curvature having a radius r equal to half the lug thickness s.

These various profiles can all be produced by the machine of FIG. **1** with the aid of different cam disks **5**.

Where only a single carriage **11**, **13** and one grinding tool **23**, **25** is provided, the same profiles can be formed if the shaft **4** is rotated through a full or nearly full turn instead of half a turn, the two opposite lug faces being then machined successively rather than simultaneously.

In FIGS. **2** and **3** I have shown an apparatus representing a kinematic inversion of the system of FIG. **1**, with a rotatable tool mounting and a stationary workpiece holder. The latter comprises a machine bed **67** carrying the clamp jaws **8** which, as in the preceding embodiment, close around the workpiece **9** to hold the lug thereof centered on an axis of rotation O. A beam **32**, rigid with machine bed **67**, carries a threaded stem **34**, fastened to it by a nut **33**, a shoulder **36** of which engages a pair of bearing blocks **38** held together by bolts **37**. Stem **34** is rigid with a stationary cam disk **35**. A pair of radially movable carriages **44** are suspended from the blocks **38** by respective pairs of leaf springs **39** which are generally U-shaped, with bight portions **40** resting on ledges **41** of these blocks and with bent-over extremities **42** received in recesses **43** of the carriages. Each carriage **44** has a radially extending dovetail groove **49** for the guidance of a respective slider **48** whose position relative to the carriage may be adjusted by means such as the screws **21** of FIG. **1**; the adjustment position may be read on a respective scale **68**.

The two carriages **44** are drawn toward each other by a spring **52** anchored to a pair of pins **70** within confronting central recesses of these carriages. Rollers **50**, journaled on the sliders **48**, are thereby held in contact with the peripheral surface **51** of cam disk **35**.

Each carriage **44** has a depending boss **45** forming a journal bearing for the shaft of a respective milling tool **31** also carrying a pulley **46** engaged by a belt **47**. The two belts **47** pass on opposite sides of the beam **32** which has two relatively offset sections **32*a*, 32*b*** to permit the swing of each belt about central axis O through an arc of approximately 180°. An upward extension **32*c*** of the beam supports a turntable **66** which is rotatable about the axis O by a tubular shaft **69** and nonillustrated drive means. A shaft **71**, driven by a high-speed motor also not shown, coaxially traverses the shaft **69** as well as the turntable **66** and carries a bevel gear **72** meshing with two similar gears **73** on the shafts of a pair of pulleys **74** embraced by the belts **47**. Thus, the entire assembly **38–50** can be entrained by the turntable **66** about axis O, via belts **47**, in an oscillating motion independently of the rotation of the millers **31** by the same belts about bearing axes symmetrically inclined to the horizontal. If necessary, that assembly could also be linked with the turntable by additional elements of a more rigid nature.

As will be readily apparent, the system of FIGS. **2** and **3** operates in essentially the manner described above with reference to FIG. **1**, cam disk **35** determining the radial separation of the tool supports **45** in any relative angular position of the rotatable assembly and the stationary workpiece **9**. In a starting position, perpendicular to the one shown, the operation of the milling tools **31** is again sufficient to allow the emplacement and removal of the workpiece upon a loosening of the clamp **8**. Naturally, the milling tools **31** could be replaced by the grinding wheels **25** of FIG. **1**, or vice versa.

Since the system of FIGS. **2** and **3** does not require any movement of the needle **9** during the machining of its butt **10**, it could be readily installed on the bed of a machine performing other operations such as the shaping of the needle tip, for example.

I claim:

1. An apparatus for shaping opposite narrow faces of a transverse lug on a flat elongate workpiece stamped from sheet metal, comprising:

a workpiece holder provided with cam means;

a tool mounting;

drive means for rotating said tool mounting and said workpiece holder relatively to each other about a central axis;

clamping means on said workpiece holder for securing a workpiece in a position perpendicular to said central axis with its lug centered on said central axis;

a pair of carriages symmetrically disposed on said tool mounting with reference to said central axis with freedom of radial displacement relative to said tool mounting;

a pair of journal bearings supported on said carriages with bearing axes symmetrically inclined to a plane which is perpendicular to said central axis;

a pair of power-driven tools rotatably journaled in said bearings for engagement with said workpiece;

a pair of cam followers on said carriages coacting with said cam means for controlledly displacing said carriages toward and away from said central

axis during rotation of said workpiece holder relative to said tool mounting; and

spring means interconnecting said carriages and urging same toward said central axis.

2. An apparatus as defined in claim 1 wherein said central axis is vertical.

3. An apparatus as defined in claim 2 wherein said carriages are provided with spring legs resiliently connecting same with said tool mounting.

4. An apparatus as defined in claim 1 wherein said spring means comprises a tension spring.

5. An apparatus as defined in claim 4 wherein said cam means comprises a cam perpendicular to said central axis, said cam-follower means comprising a pair of rollers contacting said cam disk at diametrically opposite locations.

6. An apparatus as defined in claim 1 wherein each of said tools comprises a grinding wheel.

7. An apparatus as defined in claim 1 each of said tools comprises a miller.

* * * * *